WHAT IS CLAIMED IS:

1. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a one-piece center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough; and

a hydrodynamic foil bearing assembly mounted in the bore of the center housing rotatably supporting the shaft, and comprising a foil thrust bearing assembly, a first foil journal bearing located between the compressor wheel and the thrust bearing assembly, and a second foil journal bearing located between the thrust bearing assembly and the turbine wheel;

wherein the center housing defines a cooling air supply passage leading into the bore adjacent the thrust bearing assembly for supplying cooling air to the thrust bearing assembly, the journal bearings define cooling passages arranged to receive said cooling air after said cooling air has cooled the thrust bearing assembly, and the center housing defines cooling air discharge passages arranged to receive said cooling air after said cooling air has cooled the journal bearings.

2. The turbocharger of claim 1, wherein the first foil journal bearing comprises an annular first bearing carrier formed separately from and fixedly mounted in the center housing, and the second foil journal bearing comprises an annular second bearing carrier formed separately from the center housing and first bearing carrier and fixedly mounted in the center housing, each bearing carrier mounting a foil along an inner surface of the bearing carrier.

3. The turbocharger of claim 2, wherein the bearing carriers comprise stainless steel to minimize heat transfer from the turbine to the foils.

4. The turbocharger of claim 2, wherein the bearing carriers comprise ceramic to minimize heat transfer from the turbine to the foils.

5. The turbocharger of claim 2, wherein each bearing carrier is mounted in the center housing by an undulating ring mounted about the bearing carrier and abutting an inner surface of the bore in the center housing, the undulating rings helping to thermally isolate the foils from heat transfer from the turbine and serving to radially locate the bearing carriers in the bore of the center housing.

6. The turbocharger of claim 2, wherein the thrust bearing assembly comprises an annular thrust disk and a pair of annular foil thrust bearings respectively disposed adjacent opposite faces of the thrust disk, the bearing carriers disposed on opposite sides of the thrust bearing assembly with the bearing carriers being connected to each other so as to capture the thrust bearing assembly therebetween.

7. The turbocharger of claim 6, wherein the thrust disk has a radially inner portion extending to a smaller radius than the inner surfaces of the bearing carriers, and the shaft connecting the turbine wheel to the compressor wheel comprises a stepped shaft and a shaft sleeve, the stepped shaft having a larger-diameter portion connected to the turbine wheel and journaled in the second journal bearing with an end of the larger-diameter portion abutting one side of the radially inner portion of the thrust disk, the stepped shaft having a smaller-diameter portion connected between the compressor wheel and the larger-diameter portion and extending through a central hole in the thrust disk, and the shaft sleeve being sleeved over and fixedly joined to the smaller-diameter portion and being journaled in the first journal bearing with an end of the shaft sleeve abutting an opposite side of the radially inner portion of the thrust disk.

8. The turbocharger of claim 1, wherein the center housing defines a water jacket therein for circulating cooling water for cooling the foil bearing assembly.

9. The turbocharger of claim 1, further comprising a first metal seal ring disposed about an outer surface of the shaft adjacent the compressor wheel and a second metal seal ring disposed about an outer surface of the shaft adjacent the turbine wheel, the seal rings being radially compressed between the shaft and stationary surfaces of the turbocharger for sealing the bearing assembly.

10. The turbocharger of claim 9, further comprising a stationary annular support ring fixedly mounted in the center housing surrounding the shaft adjacent the

first foil journal bearing, the first seal ring being compressed between the shaft and an inner surface of the support ring.

11. The turbocharger of claim 10, wherein an interface between the support ring and an inner surface of the bore in the center housing is sealed by a resiliently elastic O-ring radially compressed between an outer surface of the support ring and said inner surface of the bore.

12. The turbocharger of claim 10, wherein the second seal ring is compressed between the outer surface of the shaft and an inner surface of the bore in the center housing.

13. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough;

a hydrodynamic foil bearing assembly mounted in the bore of the center housing rotatably supporting the shaft, and comprising a foil thrust bearing assembly and a pair of foil journal bearings, each journal bearing comprising:

an annular bearing carrier mounting a foil assembly along an inner surface of the bearing carrier such that the foil assembly surrounds the shaft; and

an undulating ring mounted about an outer surface of the bearing carrier between the bearing carrier and an inner surface of the bore in the center housing, the undulating ring radially locating the journal bearing and providing thermal isolation between the bearing carrier and the center housing.

14. The turbocharger of claim 13, wherein the undulating rings comprise tolerance rings.

15. The turbocharger of claim 13, wherein the bearing carriers comprise a material selected from the group consisting of stainless steel and ceramic.

16. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a one-piece center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough;

a hydrodynamic foil bearing cartridge mounted in the bore of the center housing rotatably supporting the shaft, the bearing cartridge comprising a foil thrust bearing assembly retained between first and second foil journal bearings, the bearing cartridge and center housing being configured such that the bearing cartridge is insertable as a unit into the bore of the center housing from an end of the center housing adjacent the compressor.

17. The turbocharger of claim 16, wherein the first foil journal bearing comprises an annular first bearing carrier formed separately from and fixedly mounted in the center housing, and the second foil journal bearing comprises an annular second bearing carrier formed separately from the center housing and first bearing carrier and fixedly mounted in the center housing, each bearing carrier mounting a foil along an inner surface of the bearing carrier.

18. The turbocharger of claim 17, wherein the thrust bearing assembly comprises an annular thrust disk and a pair of annular foil thrust bearings respectively disposed adjacent opposite faces of the thrust disk, the bearing carriers disposed on opposite sides of the thrust bearing assembly with the bearing carriers being connected to each other so as to capture the thrust bearing assembly therebetween.

19. The turbocharger of claim 18, wherein one of the bearing carriers is piloted into the other to locate the bearing carriers coaxial with each other.

20. A hydrodynamic foil bearing assembly installable as a unit into a turbocharger, and comprising:

a foil thrust bearing assembly comprising an annular thrust disk and a pair of annular foil thrust bearings respectively disposed adjacent opposite faces of the thrust disk; and

a foil journal bearing assembly comprising a pair of annular journal bearing carriers mounting a journal foil assembly along an inner surface of each bearing carrier, the bearing carriers respectively disposed on opposite sides of the foil thrust bearing assembly with the bearing carriers being connected to each other so as to capture the thrust bearing assembly therebetween.

21. The hydrodynamic foil bearing assembly of claim 20, the thrust disk having a portion extending radially inwardly beyond the journal foil assemblies for connection to a shaft of a turbocharger.

22. The hydrodynamic foil bearing assembly of claim 21, wherein one of the bearing carriers is piloted into the other to locate the bearing carriers coaxial with each other.

23. The hydrodynamic foil bearing assembly of claim 20, wherein each bearing carrier has an undulating ring mounted about an outer surface of the bearing carrier, each undulating ring defining a plurality of circumferentially spaced undulations that project radially outwardly of the bearing carrier for contacting an inner surface of a housing in which the bearing assembly is mounted.

24. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough; and

a hydrodynamic foil bearing assembly mounted in the bore of the center housing rotatably supporting the shaft;

wherein the center housing defines a water jacket therein for circulating cooling water to cool the center housing and thereby cool the foil bearing assembly.

25. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough;

a hydrodynamic foil bearing assembly mounted in the bore of the center housing rotatably supporting the shaft;

wherein the center housing defines a cooling air supply passage leading into the bore for supplying cooling air to the foil bearing assembly, and cooling air discharge passages arranged to receive said cooling air after said cooling air has cooled the foil bearing assembly;

a cooling air supply line coupled to the cooling air supply passage of the center housing; and

a filter arranged in the cooling air supply line for removing oil vapor from the cooling air before the cooling air is supplied to cool the foil bearing assembly.

26. A turbocharger comprising:

a compressor comprising a compressor housing and a compressor wheel mounted in the compressor housing;

a turbine comprising a turbine housing and a turbine wheel mounted in the turbine housing;

a shaft connecting the compressor wheel to the turbine wheel;

a center housing disposed between and mounted to the compressor and turbine housings, the center housing defining a bore that receives the shaft therethrough;

a hydrodynamic foil bearing assembly mounted in the bore of the center housing rotatably supporting the shaft;

wherein the center housing defines a cooling air supply passage leading into the bore for supplying cooling air to the foil bearing assembly, and cooling air

discharge passages arranged to receive said cooling air after said cooling air has cooled the foil bearing assembly;

a cooling air supply line coupled to the cooling air supply passage of the center housing; and

a reverse pitot tube connected to the cooling air supply line for extracting cooling air from an engine air intake and delivering the cooling air into the cooling air supply line.

27. The turbocharger of claim 26, further comprising a filter arranged in the cooling air supply line for removing oil vapor from the cooling air before the cooling air is supplied to cool the foil bearing assembly.

28. A method for operating a turbocharger having foil bearings and having a turbine with a variable nozzle, wherein the variable nozzle is structured and arranged to receive exhaust gas from an engine and supply the exhaust gas to a turbine of the turbocharger, the method comprising partially closing the variable nozzle at engine idle condition so as to increase the idle speed of the turbocharger such that the foil bearings are prevented from stalling and stopping.